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Evaluation of resting-state functional connectivity in MEG signals of Alzheimer's disease and mild cognitive impairment subjects with minimum spanning trees

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Studying mild cognitive impairment (MCI) may help to understand early Alzheimer's disease (AD). Current diagnostic guidelines of AD acknowledge that some biomarkers can offer information about AD pathology but those biomarkers provide limited temporal information about brain activity [1]. Instead, the magnetoencephalogram (MEG) is a non-invasive recording of brain activity with high temporal resolution [2].
As AD is hypothesised to be a disconnection syndrome, estimating functional connectivity between MEG signals provides an excellent opportunity to analyze whole brain activity in this disease. Graph theory is a framework that only recently has been applied to the study of connectivity in the human brain [3].
We have analysed resting-state MEGs recorded from 26 controls (CON), 18 MCI subjects and 36 patients with AD at 169.54 Hz. Artefact-free MEG epochs of 10 seconds were selected for analysis and inspected in blocks of 2s with 50% overlap. We computed the imaginary part of coherence (ImCOH) and the debiased weighted Phase Lag Index (wPLI) between pairs of MEG channels with FieldTrip [4]. These measures were selected because of their robustness to common sources. For each subject, the adjacency matrices computed with each of these connectivity metrics for the classical spectral bands (δ, θ, α, β and γ) were transformed into binary graphs by computing their minimum spanning tree (MST) [5]. The MSTs were characterised with their diameter, leaf number, and characteristic path length (*L*).
There were significant differences between the CON and MCI groups for *L* in the δ and θ bands, diameter in the θ band and for number of leaves in the δ and θ bands. Between CON and AD subjects, differences in *L* and diameter were identified in the β band. Dissimilarities were also seen between MCI and AD groups for MST diameter in β, leaf number in δ and θ, and *L* in α and β. The values of the graph metrics for MCI subjects tended to fall outside the range of CON-AD for *L* in δ, θ, α and β, for diameter in θ and for leaf number in δ and θ.
These results relate to computational studies that have found that transient increases in activity and connectivity of brain activity in MCI may not be compensatory but pathological [6].

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